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SCIENCE: A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

100 Liberty St., Utica, N. Y. Garrison, N. Y.
New York City: Grand Central Terminal

Annual Subscription, $6.00. **Single Copies, 15 Cts.**

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., Under the Act of March 3, 1879.

THE HISTORY OF CHEMISTRY IN AMERICA WITH REFERENCE TO YALE[1]

I AM indeed grateful for the opportunity of speaking to you on the "History of chemistry in America with reference to Yale." This is an epoch occasion, and while we rejoice in the possession of this magnificent, palatial edifice, designed for the service of chemistry, it is well in this moment of exultation to take a backward look and note the

> rock from whence we were hewed and the hole of the pit from whence we were digged.

So that, with your permission, I shall briefly touch upon facts

> pick'd from the worm holes of long vanish'd days and from the dust of old oblivion rak'd.

Chemists—American chemists—in tracing the history of their science, are apt to turn to other countries. For chemistry was born in the dawn of civilization and to older lands one looks for its gradual evolution. As the oldest of the experimental sciences, it is coexistent with man's own rise and development. One need not search far to find evidences of its presence. Yet, Americans have frankly admitted their ignorance of the earliest days of chemistry in this western world. In fact, it has only been within the last quarter of a century that any effort has been put forth to ascertain when chemistry had its beginnings among us and what contributions it has made to the upbuilding of society.

It is to Jamestown, Virginia, founded in 1607, that the student of the history of chemistry must go, for there in the year 1608, before the ring of the axe was heard in the forests of America, bold spirits erected a glass house "in the woods" producing a product which was sent home in crude form, but still proof of the possibilities of an industry which might con-

[1] Address at the dedication exercises of the Sterling Chemistry Laboratory at Yale University, April 4, 1923.

tribute to the maintenance of the settlement and to the coffers of the mother land. Glass beads made in that glass house exist to-day, showing that this product of chemical activity had for its purpose a means of effecting trade with the aborigines, who were attracted by the pearly, colored objects. And in 1619 two or three furnaces for the reduction of iron ores were in operation not far away.

Chemistry was rapidly serving man in this then distant land at a day less than a century and a quarter after its discovery by the immortal Columbus. What more might have been accomplished in addition to the extraction of coloring matter from new plants, in addition to the isolation of substances possessing medicinal virtue, can only be conjectured, for further attempts were frustrated by the frightful, appalling massacres perpetrated by the Indians in 1622. The glass house and furnaces were completely demolished. Dead was chemistry in its applications at Jamestown.

To the Old Bay State the student must next go. For there it was that John Winthrop, the younger, a graduate of Dublin, an early member of the Royal Society, inaugurated chemical work by the development of ore industries which he carried far along in the state of Connecticut, of which he became the first governor. He held frequent correspondence with scientific friends in London. At their suggestion, and following, too, his own thought, he experimented widely, bringing to light many highly interesting facts afterwards placed upon the pages of the *Proceedings* of the Royal Society. As an associate of the leading alchemists of England, as a believer and promoter of the art of transmutation of the baser into the nobler metals, he breathed into the atmosphere about him the spirit of the projector or alchemist; and traces of that spirit continued far into the eighteenth century, subtly enchaining a son of Yale, born in New Haven, a minister of the Gospel, a lawyer, and again a preacher of the Word, and finally seventh president of Yale—*Ezra Stiles*.

It is he who must be regarded as Yale's first promoter of chemistry. In existing records it is noted, among other things, that Stiles repeated Priestley's experiments on fixed air; that he impregnated water with it, thereby making artificial "spa water"; and that in his leisure moments, generally at night, he tried certain reagents and wrote:

> If spirits of sea salt or the muriatic acid be drawn over the semi-metal called mangenese, it becomes a solvent of gold.

This fact had been mentioned by a Mr. Jones, who delivered a chemical lecture in New Haven. And from this same Mr. Jones, Stiles had received a quantity of vitriolic æther which apparently engaged his study for quite a little while. He observed that

> the æther imbibed a solution of gold and the next day when commixt with the *aqua regia* was again separated and held the gold distinctly separated.

All this while Stiles was reading Macquer's "Chemistry," from which he made a selection of experiments, performing them with more or less success, always at night. He was truly an enthusiastic student of chemistry. Men who had had experience in the science visited him and together they held discourses on chemistry and made inquiry concerning the hermetic philosophy. Stiles was in ecstasies when Dr. Eneas Munson, of New Haven, showed him a piece of malleable, whitish metal "which he himself made within a month past. It was fixed mercury, the first I ever saw," said Stiles.

One gathers from the notes of Ezra Stiles that in addition to his many duties as president and professor in Yale, his fondness for chemistry led him to speak of it and of the remarkable discoveries, unfolded through its agency, to his classes. He corresponded with Franklin, whom he idolized, and to him he gave account of his practical work in the science. Self-trained, it is but natural that he should have presented his subject in a crude form. There is also no question but that the matter of projection or transmutation was in his mind. He endeavored to free himself from it, with but partial success, for he was the intimate of Dr. Munson, Judge Danforth and the Reverend Mr. West, of whom he said:

> They believed in the reality of the Philosopher's Stone, although neither of them ever obtained it.

And in his diary occur these words:

> Terra Fol, æthere sublatâ hodie.

Absolute proof that he was really dabbling in alchemy! And yet, perhaps because in the thought of most people alchemy, the black art,

belonged with witchcraft, Ezra Stiles did not care to be allied with those who practiced the latter. He was perturbed, and a little suspicious of himself, exclaimed:

I am not versed in the books of the adepts. I have seen but a few of these authors and read less. Perhaps all the little I have read collectively would not equal a common octavo volume. I am infinitely less acquainted with them than any other of the sciences in the whole encyclopedia. I have never observed the extracted sulphur of gold *in terra*. I have no practical knowledge of the matter; the few ideas I have about it are only imaginary, conjectural and speculative. Coram Deo Veritas.

Dear old Dr. Ezra Stiles! We rejoice that you turned from witchcraft, which looks backward, but are profoundly thankful that you were, despite your lovely disclaimers, allied with alchemy, which looks forward; for truly it was experimental science in the making, a science that does not yet acknowledge its finite bounds, "but aspires, star-eyed, to illimitable possibilities." Yes, you were Yale's first experimenter in the science which has called us together this morning, and may your benign, fatherly spirit at this moment rest approvingly upon all who are here rejoicing with Yale in this new abode of chemistry.

Time rolled on. The soul of Ezra Stiles went out on the lonesome trail, and another son of Yale, who like Stiles became a lawyer, but animated by the latent purpose of the dear old alchemist in his predilection for chemistry heeded the call of *alma mater*, in 1802, to the chair of chemistry. Before assuming its duties, however, he journeyed to Philadelphia, then the center of art, literature and science, that he might sit at the feet of James Woodhouse, the Napoleon of experimental endeavors in America. Let us for a few moments follow this eager, earnest student—Benjamin Silliman, the elder.

What a delightful company awaited him in his lodging house in the city of Brotherly Love: Horace Binney, Charles and Elihu Chauncey and Robert Hare—young men of great prominence—educated men—men of elevated position in society, their manners in harmony with their training. Silliman wrote:

As Robert Hare was a brewer of porter and was one of our number, his porter was in high request, and, indeed, it was of an excellent quality. He was a genial, kind-hearted person, a year younger than myself, and a proficient in chemistry upon the scale of that period. Hare invited me to join him in the study of his oxy-hydrogen blowpipe.

While perceiving that this instrument was ingenious, Silliman saw that it was unsafe as regards the storage of gases, and its correction in this particular was entirely due to him.

It was a genuine pleasure for Silliman to stand by his friend Hare in 1802 when the latter repeated his blowpipe experiments before Dr. Joseph Priestley, James Woodhouse, Thomas Cooper, Adam Seybert and others. One wishes that he might have a picture of that group!

The possibilities of the oxy-hydrogen flame were constantly in the thought of Silliman, and the very first pneumatic trough, including Hare's blowpipe, was constructed by Silliman for the laboratory of Yale College in 1803. In later years he wrote:

The fusion and combustion and complete dissipation of platinum, gold, silver, nickel, cobalt and most of the metals, and the fusion of the principal earths and of their more refractory compounds have been made familiar and easy class experiments of every course of chemistry in Yale College for years.

Silliman and Hare were pupils of Woodhouse, who, when interrogated upon the brevity of his didactic lectures, replied

that no man could dwell in discussion on a single topic more than five minutes without talking nonsense.

They were acquainted with his laboratory and the remarkable experimental work conducted by him, but in their leisure hours did very independent thinking and experimenting in their own laboratory in the basement of their lodging house.

To them it was delightful and profitable to meet Dr. Priestley very frequently at the home of Wistar. As Silliman was taking a broad view of science and its teachings, his hours with Wistar, the anatomist; Barton, the botanist, and Seybert, the mineralogist, were precious. In his mind were revolving brilliant schemes for the elaboration of all these subjects side by side with his thoughts on chemical research.

His friendship with Hare was unique. From their correspondence, continuing through life,

it may be inferred that they were believers in and real promoters of genuine experimental science. They discussed its possibilities to and fro, and mutually submitted plans for the elucidation of the chemical and physical problems which interested them. While their active coexperimentation ceased upon Silliman's return to Yale in 1804, they wrote many letters regarding their common love—chemistry.

Silliman began his teaching career in a subterranean lecture room fitted up for his laboratory, which was fifteen or sixteen feet below the surface of the ground. It was inconvenient! It was so gloomy—but there he courageously worked for fifteen years. There he analyzed minerals and meteorites and invented and perfected apparatus for demonstration purposes in chemistry and physics. In 1805 he was off again. This time to Europe, meeting in London Frederic Accum and Humphry Davy; and in Edinburgh, John Murray and Thomas Charles Hope, the polished, stately and formal gentleman who succeeded the gifted Joseph Black. In Edinburgh, Silliman fairly reveled in the teachings of the Wernerian and Huttonian geological schools. He grasped the prevalent geological thought. But in 1806 returned to New Haven, his days of tutelage passed and his actual teaching career begun. Mineralogy, geology and pharmacy were added to chemistry. He proved a most inspiring teacher and founded in 1818 that splendid medium of circulating the scientific work of his colleagues and himself—the *American Journal of Science and Arts*, now in its one hundred and fifth year; and further he was prominent in the establishment of many Yale activities, flourishing at this moment—the art gallery, the astronomical observatory, the medical school and the Sheffield School of Science.

But to look once more upon Silliman as a research chemist. His *fidus Achates*, Robert Hare, had devised an unusual battery—a plunge battery of powers not before suspected. Hare transmitted all his experiences with this instrument to Silliman and even sent him a well-constructed *deflagrator*, as it was termed. Both experimenters marvelled at the occurrences on attaching carbon rods to the deflagrator and studying the arc which ensued. In March, 1823, just one hundred years ago, Silliman wrote Hare:

> I gave you . . . an account of the fusion and volatilization of carbon by the use of your galvanic deflagrator. I have now to add that the fusion of plumbago (black lead) was accomplished yesterday by the same instrument.

Again Silliman sought to ascertain the behavior of diamonds in the oxy-hydrogen flame, and said:

> They exhibited marks of *incipient fusion*.

And thus it continued. Should the thought enter the mind of any one that Silliman was not a producer in his favorite science, let him read the voluminous correspondence which passed between him and Robert Hare. He will then promptly assign him a high place among researchers. The story of his laboratory would make a good prelude to the history of university education in this country as distinguished from collegiate.

Silliman possessed the genuine instinct of discovery, the quick recognition of new and interesting facts, and enthusiasm in following them up to novel and important results. That his successes in other directions somewhat overshadowed them does not detract from their permanent value

> for it must not be forgotten that those who smooth the road to science and facilitate its acquisition to others are often more permanently useful than such as are supereminently learned themselves; the greatest personal or mental acquirements die with the possessor; but those who labor that others may be wise are a benefit to all posterity (Mavor).

Is it not to the inspirational teaching of Silliman that American science is indebted for Dana, world-renowned geologist and mineralogist; Brush, whose exhaustive mineralogical chemical studies are authoritative everywhere; Johnson, pioneer leader in chemistry applied to agriculture; Willard Gibbs, first among physical chemists of modern times; T. Sterry Hunt, profound in chemical philosophy and theory, and hosts of others—giants in the world of natural and physical science?

Last evening I stood "under the friendly silence of the moon" before the bronze figure of Benjamin Silliman out on yonder campus; how I wished that I might speak out my thoughts to you! I did whisper to him:

> To you, revered master, we are indebted for this magnificent laboratory. Your spirit, mysteriously conveyed to your successors in order, caused science—particularly chemical science—to so permeate the curriculum of Old Yale that the

subterranean laboratory has been brought to the surface, enlarged, developed and endowed, that its rays may illuminate the world—far and wide.

We chemists here assembled say to Yale that we are not envious—no, we are happy, felicitating you with all our hearts and with you thanking God

that Silliman, the elder, was born.

While to President Angell, I'd add:

As one arranges in a simple vase
A little store of unpretending flowers,
So gathered I these records of past hours,
And trust them, honored sir, to thy grace.

EDGAR F. SMITH

PSYCHOLOGY AS A LIFE WORK

THE student facing the choice of his life work should consider two matters with especial care. These are his abilities and interests on the one hand and, on the other hand, the opportunities that are offered by a profession for personal development, public service, and the respect of those whose respect is most worth while to him. Ability and interest are personal. Their true estimation requires self-criticism and the advice of those who know one best. The opportunities that a profession offers may be learned from the candid statements of experts in the field.

The field of psychology.—Psychology is primarily the science of human experience, behavior and personality. It reaches down into childhood and animal life. It reaches out into the abnormal and the unusual, to depravity and genius. A sound psychology is needed in medicine and the social sciences, in religion and art, in education, law and politics, in industrial management, vocational guidance and social service. It is involved in our attempts to answer some of the greatest riddles of the universe, such as the relation of brain and mind, the origin of intelligence, and the basis of right conduct. It seeks to know the sources and organization of experience and motives, the integration of human personality, and the bonds that connect us with our fellows. Every phase of human feeling, thought and action from birth to death belongs to the field of psychology in as far as it is capable of scientific observation, description and analysis.

Prerequisites to a career in psychology.—The first prerequisite to a career in psychology is a systematic knowledge of its tradition. This is generally initiated by an elementary course which introduces the student to the entire field. It should be supplemented by courses in analytical psychology, genetic psychology, comparative psychology, physiological psychology and social psychology. In addition, the student should gain as extensive laboratory experience as is practicable. Command of the French and German languages is a necessary auxiliary since a large part of the scientific literature is published in these languages. The student who chooses psychology for a career should have a good foundation in philosophy, mathematics, biology, physiology, physics and chemistry. Courses in applied psychology should vary according to the interests of the student. They should be supplemented by thorough study of the several fields to which they relate.

Elementary work in psychology is provided for in every well-equipped college of liberal arts. For his advanced study the student who wishes to specialize in psychology should go to that university whose faculty most nearly meets the needs of his special interests.

Types of careers in psychology.—As in most of the sciences, there are three main types of careers in psychology. These are teaching, research and applied psychology. Of these three, teaching is the only standardized career at the present time. It is usually the base from which one may develop research or applied psychology. Teachers of psychology are employed in colleges and universities, normal schools and some other technical schools. There is room not only at the top but all along the educational line for intelligent, thoroughly trained and devoted teachers of psychology. All such can be certain of earning a living and rendering human service the value of which can not be measured in dollars.

A teacher of psychology should always be more or less of an investigator. This is probably true of all teachers. Unless one appreciates scientific problems as he meets them and tries to collect data for their solution he can scarcely appreciate the meaning of science, its evolution and the dangers that beset scientific generalization. Moreover, he will miss the joy that comes to the explorer who pushes the dark boundaries of the unknown a little further away. It would, however, be disastrous for a

teacher of psychology to supplant the great scientific traditions by his narrow lines of investigation.

Careers of pure research unmixed with other duties are rare in any field of science. They are especially rare in psychology and can scarcely be held out as an exclusive aim in the choice of psychology as a profession.

Applied psychology.—The applications of psychology are as numerous as human endeavors. Applied psychology, however, is still in its infancy though it has rendered notable service in several directions. Self-supporting careers may at present be found in educational psychology, in clinical psychology and in industrial and business psychology. Each of these lines will be described by an expert in the field. None of these divisions of applied psychology is standardized or developed to a point where one can rest content with present methods and results. In addition to a thorough grounding in his field of science and in the field of its application, an applied psychologist needs ingenuity, initiative and administrative ability. For those who possess the requisite qualities and training there is no limit to public service and financial rewards.

RAYMOND DODGE
WESLEYAN UNIVERSITY

EDUCATIONAL PSYCHOLOGY

The most common career for a man or woman qualified in educational psychology is to teach in a department or school of education in a university or in a normal school. The qualifications are the same as for teachers in institutions for higher education in general, except that more skill and care in teaching itself is expected, and that a knowledge of the theory and practice of education is desirable.

There is an increasing demand for experts in psychological and educational measurements to work in the educational department of a state or city or in large private institutions. Such a position will usually be distinct from that of the clinical psychologist to be described later, though in some communities, one person will be responsible for both kinds of work. General scientific ability, knowledge of educational practice, industry, adaptability and good sense, are the most necessary qualifications. Mathematical insight, ability to organize a mass of details, and ability to manage children in interviews and tests are desirable.

In so far as he uses his undergraduate studies to prepare himself for either the teaching or the practice of educational psychology, the student may favor courses in physiological psychology, educational psychology, tests and measurements, the psychology of childhood, elementary education, secondary education and educational administration. His graduate studies should, if possible, include thorough work in individual psychology (including the psychology of exceptional children and the technique of standard tests), the psychology of the elementary school subjects and the theory and practice of psychological and educational measurements.

EDWARD L. THORNDIKE
TEACHERS COLLEGE,
COLUMBIA UNIVERSITY

CLINICAL PSYCHOLOGY

The rapidly growing appreciation of the value of psychological facts and principles in directing individuals who are poorly adjusted to their environments has opened up many lines of psychological research and practice. The federal government, state institutions and individuals are seeking psychologists to devise and apply tests to determine many things besides retardation, chiefly individual exaggerations, idiosyncrasies, aptitudes, tendencies and capabilities, with special reference to the prevention of adverse happenings and to the prediction of probable means of successful adjustments. This field is, therefore, closely bound up with educational, occupational and social applications of psychology, and also with the physical side of life which is cared for by the medical practitioner. It will be appreciated that preparation for practice or research in this field involves some acquaintance with the facts of disease from both the physical and mental sides, as well as with the means of treatment and their limitations and interrelations. Practice and research also require the physician's mental attitude; sympathy but not sentimentality, an interest in the welfare of the individual and of society which over-balances a natural shrinking from diseased states or the seamy side of life, and an understanding of the frailties and foibles of man. For the psychol-

ogist with special training and aptitudes the opportunities in private work or in institutional employ are not surpassed financially or scientifically by that in any other field.

SHEPARD I. FRANZ
ST. ELIZABETH'S HOSPITAL,
WASHINGTON, D. C.

CAREERS IN INDUSTRIAL PSYCHOLOGY

The world of business and industry is not exactly clamoring for psychologists to come and show how factories should be operated, offices organized and sales increased. Indeed, hardly more than one or two men are earning a livelihood in industry to-day as *psychologists*.

There are, to be sure, several trained psychologists who are ably filling business positions—in personnel administration, industrial training, business analysis, sales promotion and management and advertising. Their duties, however, are much like those of other executives who may have studied only in the school of actual business experience. The doctor of philosophy who specializes in industrial psychology can not be confident of a chance to earn his living practicing the applications of his science in a business concern. He should first fit himself for university teaching and research, for this is the main trunk from which branch the opportunities for careers in industrial psychology.

Three outstanding assets for a career in industrial psychology are: a sound training in scientific method; the capacity to be genuinely interested in all sorts of people and the personality to deal effectively with them; and superior practical judgment, especially where money values are concerned.

It is a common error to imagine that an industrial psychologist does not need to be exacting in his scientific ideals and rigorous in his procedures, as does the experimentalist in a university laboratory. When selecting psychological methods for practical use—in an employment office, for example— he must know and evaluate all the considerations of reliability of one method *vs.* another, and *in addition* he must be able to evaluate relative costs in comparison with returns in dollars. For this reason it is essential for the industrial psychologist to have a good grounding in economics, including cost-accounting and industrial management. Mastery of the technique of constructing and administering tests is also of secondary importance, except as it may serve as a discipline in scientific method. The bulk of the training must be in general systematic psychology and in statistical and experimental method. To be an industrial psychologist one must first of all be a psychologist.

For the young man or woman, then, with a strong bent toward practical psychology, the first objective should be to secure the training necessary for doing good teaching and research in general and experimental psychology. Later, when one has made his place in a university or a research bureau as a teacher or an assistant investigator, the psychologist who combines practical good sense with scientific thoroughness and with ingenuity may be certain of finding opportunities in any industrial community for working on the most fascinating practical problems. His financial rewards will then be proportionate to his resourcefulness and his ability to produce an output of cash value to industry.

W. V. BINGHAM
CARNEGIE INSTITUTE OF TECHNOLOGY,
PITTSBURGH, PA.

EDWARD WILLIAMS MORLEY

EDWARD WILLIAMS MORLEY was born in Newark, N. J., January 29, 1838. His parents were the Reverend Sardis B. Morley and Anna Treat Morley. Soon after his birth they moved to Hartford, Conn., and thereafter for the next twenty-five years his life was spent in New England. He graduated from Williams College in 1860, and from Andover Theological Seminary in 1864, and later taught in the South Berkshire Institute at Marlboro, Mass. He also spent a few years as minister in the Congregational church. In 1868 he married Isabella Ashley Birdsall, of Winsted, Conn., and a year later was called from the pastorate of the Congregational Church in Twinsburg, Ohio, to be professor of natural history and chemistry in Western Reserve College, then located in the neighboring town of Hudson. Later the college was moved to Cleveland and became Adelbert College of Western Reserve University.

During the first years at Hudson Professor

Morley taught not only chemistry and physics but also mathematics, mineralogy, geology and botany. Chemistry was always, however, his chief interest, and he at once had a small room fitted up as a chemical laboratory, where, as one of the early catalogues states, "The class perform, under the guidance of the professor, all those experiments which are suitable for them, while those which demand more experience are performed for the class by the teacher." A course in quantitative analysis was also given at this early date.

Morley was always a tireless worker. In 1873 he also became professor of chemistry in the medical department of the college in Cleveland, which necessitated his spending much time in traveling back and forth between the two towns. In addition he was always engaged on some research and besides undertook analytical work for certain industrial firms in order to obtain funds to finance his needs for special apparatus and books, the college not being able in those days to afford to purchase supplies except those actually required by the students. After the college had moved to Cleveland in 1882 and had acquired a greater endowment, he was able to devote himself to teaching chemistry exclusively and in 1888 to give up his connection with the Medical School. In 1898 the trustees of the college voted that, in consideration of his great scientific achievements, sufficient assistance would be provided so that he could do as little teaching as he wished and devote his time to research. He, however, chose to continue most of his teaching, and taught general chemistry and quantitative analysis until he retired as professor emeritus in 1906.

Professor Morley prepared altogether fifty-five papers for presentation before scientific societies or for publication. His first work of importance, undertaken while in Hudson, was on the relative proportion of oxygen in the air (1878-81). In the course of this he devised and constructed an apparatus for determining the proportion of oxygen in the air rapidly and with great precision. He made analyses of the amount of oxygen in the air on 110 consecutive days in order to accumulate data bearing on the so-called Loomis-Morley hypothesis, which was put forward to account for the variation of the oxygen content of the air with the change of barometric pressure. According to this hypothesis deficiency of oxygen was supposed to occur at times of high barometric pressure, due to downward currents bringing air from high altitudes to the surface of the earth. He summed up his results in the following words: "The theory that deficiencies in the amount of oxygen in the atmosphere are caused by the descent of air from an elevation fairly well agrees with the facts."

The outstanding labor of his life, and for which Morley is best known among chemists, is his work on the density of oxygen and hydrogen and the ratio in which they combine. He was occupied with this during most of the twelve first years he spent in Cleveland and had it ready for publication in 1895. It came out as Smithsonian Contribution to Knowledge, No. 980, and also appeared in German in the *Zeitschrift für physikalische Chemie.* This research placed him in the very first rank of scientists. In it one sees his remarkable insight into the fundamental nature of the problem, his great skill in devising and manipulating apparatus, his precision of measurement and his great patience and perseverance in overcoming obstacles at times seemingly insurmountable. It is a remarkable tribute to his work that now, after nearly thirty years, the accepted values of these quantities, which are the averages of the best recent work in this field, are practically identical with those found by him.[1]

Many other papers published by Morley during or after this period were the results of work bearing on this central problem, as, for example, "On the amount of moisture remaining in a gas after drying with sulfuric acid," "On the amount of moisture remaining in a gas after drying with phosphorus pentoxide," and "On the vapor tension of mercury at ordinary temperatures."

He devised a gauge for measuring small differences of gaseous pressure. This was of two types, one of which he used in collaboration with Professor D. C. Miller in determining the

[1] To consider the density of oxygen alone: in the annual report of the Committee on Atomic Weights for this year (1923) the average of recent determinations is given as 1.42892, which is identical with Morley's figures when reduced to the same standard.

thermal expansion of air, nitrogen and a few other gases, and the other with Mr. C. F. Brush, by means of which differences of gaseous pressure as small as one ten-thousandth mm. of mercury could be measured.

Professor Morley was as eminent a physicist as chemist. His characteristic for precision of measurement is exhibited by his early papers on "Rulings on glass" and "The probable error of micrometric measuremeents." After coming to Cleveland he collaborated with Professor Michelson in the development of the interferometer, an instrument for measuring lengths in terms of the wave-length of light. With this instrument they undertook their well-known experiment on the relative motion of the earth and the luminiferous ether, which was carried on at the same time as the research on the densities of oxygen and hydrogen. A little later with Professor W. A. Rogers he perfected a method for measuring the expansion of metallic rods with the interferometer. After the work on oxygen and hydrogen was out of the way he again resumed the experiments on the drift of the ether with Professor D. C. Miller. Although these experiments yielded negative results as far as the expected magnitude of the motion was concerned, they aroused a great deal of interest, and Professor Miller has since repeated them under more favorable conditions at Mount Wilson Observatory. Professors Morley and Miller also made use of the interferometer in measuring the velocity of light in a magnetic field.

Professor Morley with all his greatness was by disposition of a most retiring and modest nature, almost too much so for his own good, as he was but little known outside the ranks of chemists and physicists. He was in no sense a self-advertiser. However, after the completion of the work on oxygen and hydrogen in 1895 honors were showered upon him. He was president of the American Association for the Advancement of Science in 1895, and of the American Chemical Society in 1899. In 1901 he was the American delegate to the General Conference on International Weights and Measures in Paris. Previously, under the Harrison administration, he was one of the four members at large of the committee to receive the United States Prototype Metric Standards at the White House. In 1907 he was awarded the Sir Humphry Davy Medal by the Royal Society of London, in 1912 the Franklin Institute of Philadelphia conferred upon him the Elliot Cresson Medal, and in 1917 he received the Willard Gibbs Medal from the Chicago section of the American Chemical Society. In 1912 he was honorary president of the Eighth International Congress of Applied Chemistry. He received honorary degrees from many universities: LL.D. from Western Reserve in 1891, from Williams in 1901, from Lafayette in 1907, from the University of Pittsburgh in 1912, and D.Sc. from Yale in 1909. He was an honorary member of the Royal Institution of London, the Chemical Society of London and the American Chemical Society. In addition to this, he was a member or fellow of the National Academy of Sciences, the American Philosophical Society, the American Society of Arts and Sciences and of many other learned societies in this country and abroad.

Professor Morley realized the importance of books in enabling one to keep abreast of the work being done in one's science. Since the college was unable to purchase books for him, he began at an early date to collect a library of the principal chemical journals and by the time he had completed his work on oxygen and hydrogen he owned personally one of the most complete sets of journals on pure chemistry to be found between New York and Chicago. He even purchased a number of Russian journals and learned to read this language so as to gain at first hand knowledge of certain researches which interested him in that country. On his retirement in 1906 the college purchased this library from him. It is now housed in the chemical laboratory, built in 1908-1909, for which he drew plans, and which is now known as the Morley Chemical Laboratory.

Professor Morley in general enjoyed good health and was possessed of remarkable vitality. But no constitution could withstand with impunity the strain of long hours and hard work which he continually imposed upon himself up to 1895. This so impaired his health that he felt obliged to rest, and he was granted by the college a year's leave of absence (1895-1896), the only one during his entire career. This he spent in travel and recuperation abroad. After this the college authorities granted him more assistance, so

that he took life easier and was able to enjoy some of its amenities.

Next after research he enjoyed exercising his skill on difficult chemical analyses, and during his last years in Cleveland he analyzed many complex minerals for his friend and colleague, Professor H. P. Cushing, who spent a portion of his time with the New York Geological Survey. After he retired from active teaching in 1906 and went to live in West Hartford, Connecticut, he built for himself a small laboratory where he still continued making analyses of this sort for Professor Cushing and for other friends interested in geology. His last published paper was with Professor J. P. Iddings on work of this kind.

Professor Morley had a remarkably retentive mind, so that practically everything which he read was stored in his memory, whence it could be drawn whenever needed. He not only possessed a remarkable clarity of expression in writing and speaking, but what is rarer, he had the ability to make scientific and abstruse matters interesting to the layman. His public lectures on such subjects as the ether-drift experiments were always well attended and every one manifested the keenest interest in what was being said.

He was a great lover of music and a good amateur musician. In the early days he played the chapel organ at Hudson, and in his later life derived much enjoyment from the pianola. After his retirement this versatility was a great help to him in getting the most enjoyment out of life. When he became weary at his analytical work, he would turn to music for relaxation. He also took a great deal of pleasure in out-of-door life, raising gladioli or taking trips through New England in his automobile, which he always drove himself. Only last summer he and Mrs. Morley, whose death preceded his by only a few months, took a trip into northern Massachusetts and Vermont in their machine.

He was taken to the Hartford Hospital for an operation on January 21. Another operation was found to be necessary about three weeks later, which was not serious and from which he was expected to recover. Unexpected complications, however, set in and the end came on February 24, just a few days after his eighty-fifth birthday.

Thus in the fulness of years passed a truly great man. The work he left behind him in both chemistry and physics is the best memorial to his genius. His teaching service extended over a period of thirty-seven years and endeared him to several generations of students. By his colleagues he was revered for his genial personality, the wisdom of his counsel and his unselfish service. His broad culture and noble simplicity of character enriched the lives of all those with whom he was associated.

OLIN FREEMAN TOWER
WESTERN RESERVE UNIVERSITY

SCIENTIFIC EVENTS

INTERNATIONAL CONFERENCE ON STANDARDIZATION OF SERUMS[1]

IN December, 1921, an international health conference was held in London, under the auspices of the League of Nations, to discuss the standardization of serums and serum reactions; in December, 1922, a second conference for the same purpose was held in the Pasteur Institute, Paris, at the suggestion and under the chairmanship of Professor Madsen, president of the health committee of the League of Nations. Professor Neufeld, director of the Robert Koch Institute for Infectious Diseases, Berlin, who, with Wassermann, Kolle and Sachs, took part in the conference, gives a report of the proceedings in the *Deutsche medizinische Wochenschrift*, January 5, 1923. The transactions were carried on by subcommittees. The first dealt with the standardization of tetanus and diphtheria antitoxins. These investigations are nearly complete, and it is expected that an agreement will soon be reached as to a generally acceptable method of titration and standardization. Heretofore, not only have other countries used standards (immunity units) different from those of Germany, but there have been fundamental differences in titration. For example, in France, not only is Ehrlich's procedure used for the titration of diphtheria serum (combinations of toxin and antitoxin), but the effect on living diphtheria cultures is also tested.

A second subcommittee took up the question of dysentery serum, which, with us, is not re-

[1] From the *Journal* of the American Medical Association.

quired to be tested. It is certain that many unfavorable observations on dysentery serum in Germany have been due largely to the use of defective serums, and that results would be improved by a standard titration approved by the state public health service. Investigations of the antitoxin test on rabbits and mice are still being carried on.

The largest subcommittee, under the chairmanship of Bordet and Wassermann, discussed the serodiagnosis of syphilis, and several reports were read on comparisons between the original method of complement fixation, and the flocculation or precipitation methods of Sachs-Georgi, Meinicke and Dreyer. These investigations are to be continued in certain definite directions by one laboratory of each of the several countries. In Germany there have been many complaints of evils arising from the serodiagnosis of syphilis, and, in consequence, an attempt was begun last year to prevent as far as possible the injuries and untoward effects that may arise from the improper application of this delicate and practically important procedure, by adopting an officially recognized and uniform method of application of the Wassermann test. This regulation has encountered considerable opposition, especially from directors of laboratories, and it is hoped that the investigations of the health committee of the League of Nations will be of great value in preparing a revision of existing regulations, which will be necessary before long.

Two other subcommittees are engaged in investigation of the antipneumococcus and the antimeningococcus serums, respectively. With regard to the former, the subcommittee expressed the opinion that an opinion as to their efficacy would at this time be premature; however, we possess reliable methods of titration, and if antipneumococcus serums of high value according to these standards are tested in pneumonia cases which are not too far advanced, we may expect, within a reasonable time, a final and reliable judgment on the value of this form of serotherapy.

With the antimeningococcus serums, serotherapy is likewise much complicated by the fact that there are several different types of causative agent, and corresponding variations in antibodies. In Germany the state has already established standards for meningococcus serum. These standards, however, give no consideration to the different serologic types, and there is therefore need for revision. Cultures and serums of the various types of organisms are being exchanged by the laboratories conducting the investigation, and the question as to what antibodies (bacteriotropins, antiendotoxins, agglutinins, antibodies causing complement fixation) shall be used to establish the titer of a given serum is being studied according to definite standards set up by the committee. We should await the results of these investigations before we revise the official standards in Germany. This is an exceedingly important, practical question; for, in the opinion of Professor Neufeld, the antimeningococcus serum is possibly the most effective therapeutic serum yet used in the treatment of human diseases.

THE STANDARDIZATION OF SCIENTIFIC SYMBOLS AND ABBREVIATIONS

A RECENT conference held in New York City under the auspices of the American Engineering Standards Committee revealed a sentiment among engineers, scientists, government officials, business paper editors and industrial executives, emphatically in favor of the unification of technical and scientific abbreviations and symbols.

It was agreed on all sides that the standardization of abbreviations and symbols would result in inestimable mental economies. The present situation with respect to the use of abbreviations and symbols in engineering, scientific and other technical fields is comparable to a language which has degenerated into a multiplicity of dialects, each of which has to be translated for the users of the others. Abbreviations and symbols constitute an ever-growing and important part of the language of engineers, scientists, industrial editors and other technical men. The use of one symbol or abbreviation for several different terms and the use of several different symbols or abbreviations for one meaning are, however, at present causing a great deal of confusion, misunderstanding and often serious errors.

The conference was called upon requests from the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Association of Edison Illuminating

Companies, to consider abbreviations and symbols, but after some discussion of the subject it was thought desirable to include as a part of the project the graphical symbols which are used in engineering drawings, diagrams and the like, for representing instruments and apparatus and components of them.

It was agreed that the cooperation of foreign standardizing bodies should be sought in the development of the work. The importance of international uniformity in symbols is great on account of the international character of much engineering and scientific work, and the importance of reference books and periodicals in foreign languages.

The work will go forward under a committee organization developed in accordance with the rules and procedure of the American Engineering Standards Committee.

The appended list of those who attended the conference and the organizations by which they were designated will show the diversity of interest involved in the project.

Henry Norris Russell, American Association for the Advancement of Science.

Sullivan W. Jones, American Institute of Architects.

Edward J. Cheney, American Institute of Electrical Engineers.

George W. Metcalfe, American Institute of Electrical Engineers.

C. H. Sharp, American Institute of Electrical Engineers.

Edward K. Judd, American Institute of Mining and Metallurgical Engineers.

Edward V. Huntington, American Mathematical Society.

Albert P. Wills, American Physical Society.

Henry A. Ruger, American Psychological Association.

G. A. Newrath, American Railway Association —Signal Section.

C. L. Warwick, American Society for Testing Materials.

Stanley F. Morse, American Society of Agricultural Engineers.

C. B. LePage, American Society of Mechanical Engineers.

Sanford A. Moss, American Society of Mechanical Engineers.

C. M. Sames, American Society of Mechanical Engineers.

R. R. Leonard, American Society of Refrigerating Engineers.

R. D. Parker, American Telephone and Telegraph Company.

C. H. Sharp, Association of Edison Illuminating Companies.

H. Stuart Acheson, Combustion Publishing Corporation.

H. G. Knoderer, Electrical Manufacturers Council.

A. M. MacCutcheon, Electrical Manufacturers Council.

L. A. Hazeltine, Institute of Radio Engineers.

Howard Richards, Metric Association.

Kenneth H. Condit, National Conference of Business Paper Editors.

Alexander Maxwell, National Electric Light Association.

Charles E. Neil, National Electric Light Association.

W. Spraragen, National Research Council.

Sullivan W. Jones, National Research Council Engineering Division.

John T. Faig, Society for the Promotion of Engineering Education.

Sanford A. Moss, Society for the Promotion of Engineering Education.

John M. Lloyd, Society of Automotive Engineers.

W. W. Smith, Society of Naval Architects and Marine Engineers.

J. Franklin Meyer, United States Bureau of Standards.

Ray M. Hudson, United States Department of Commerce.

A. W. Whitney, chairman, American Engineering Standards Committee.

P. G. Agnew, secretary, F. J. Schlink, assistant secretary, American Engineering Standards Committee.

BOARD OF SURVEYS AND MAPS

A REPORT of the Board of Surveys and Maps of the federal government for the calendar years 1921 and 1922, dated March 5, 1923, and signed by William Bowie, chairman, has been submitted to the President of the United States.

The board was created by executive order dated December 30, 1919, and was designed to furnish the means of coordinating the activities of bureaus and independent organizations of the federal government engaged on surveying and mapping, to avoid duplication of effort by these organizations and to make the results of the greatest usefulness to the map using public. The report gives the list of the eighteen government organizations having representa-

tion on the board and the list of the twenty-two non-governmental organizations represented on the advisory council which was created to assist the board in making contact with the public.

At each public meeting, which is held bi-monthly, there have been present members of the advisory council and others who are not members of the board. The report states that the meetings have been well-attended and that there has developed a remarkable spirit of helpfulness and cooperation which has led to very beneficial results. Various bureaus of the government dealing with surveying and mapping look to the board for advice on technical matters. Several cases of cooperation have resulted from the close contact in the meetings of the representatives of the various surveying and map making bureaus. Notable examples are:

1. Cooperation between the corps of engineers and the United States Geological Survey in the topographic mapping needed by the various branches of the Army;

2. Cooperation of the Air Service of the Army and the Topographic Branch of the Geological Survey;

3. Cooperation of the United States Geological Survey and the United States Coast and Geodetic Survey with the Forest Service and with the Bureau of Soils in furnishing surveying and mapping data to the latter two organizations;

4. Cooperation between the United States Coast and Geodetic Survey and the General Land Office which has resulted in the connection of corners of the land surveying system of the country with the triangulation stations established by the former bureau.

In obedience to the executive order creating the Board of Surveys and Maps, a central map information office was established in the Interior Building for the purpose of collecting, classifying and furnishing to the public information covering all mapping and surveying data available at the several government departments and from other sources. This map information office has been of the greatest assistance to the government and to outside organizations and individuals. Much information has been furnished by it to all branches of the government service, to universities, schools, map publishers, commercial firms of all kinds, state officials, individuals of foreign countries and to the general public. The results accomplished by the map information office alone justify the creation of the Board of Surveys and Maps of the federal government.

While the Board of Surveys and Maps was not created to engage in the task of securing more funds for the several surveying bureaus in order that the topographic mapping of the country might be expedited, yet the members of the board feel that the mapping of the country should be taken up as a project and that legislation looking towards this desirable result should be enacted by congress. In the opinion of the board, the demands made on the bureaus of the government furnishing surveying and mapping information amply justify the appropriation of the necessary funds to extend the mapping at a more rapid rate than has obtained in the past.

W. BOWIE

EXECUTIVE BOARD OF THE AMERICAN ENGINEERING COUNCIL

DECISION to undertake a nationwide coal storage investigation was reached by the executive board of the American Engineering Council of the Federated American Engineering Societies at its meeting at Cincinnati, March 23 and 24. General endorsement of the plan for government reorganization, submitted to congress with the approval of President Harding and the cabinet, and continuance of the committee on Transportation, headed by Max Toltz, of St. Paul, were other outstanding features of the meeting.

The personnel of the committee to conduct the coal inquiry, which is to be made unless there is objection from the constituent societies, will be announced later by President Cooley.

The committee on procedure of the American Engineering Council some weeks ago authorized the appointment of a committee on transportation for the specific purpose of investigating and reporting to the executive board as to what, if anything, the American Engineering Council could do with propriety and effectiveness in relation to the transportation problem of the American people. The committee was instructed that it was to give consideration to all forms of transportation, that is, by railways, by motor trucks and by water.

Max Toltz, chairman of the committee ap-

pointed, made a progress report to the executive board, pointing out many of the important phases of the very complex problem. He stated that the task was such a large and ramifying one that the committee would require more time in which to advise the executive board what, if anything, it should do. He further indicated that probably the best service the American Engineering Council could render would be to cooperate with a number of national organizations which has been working in this field for years.

J. Parke Channing, of New York, chairman of the new committee on government reorganization as related to engineering matters, made a progress report indicating the active participation of the federation in this sphere.

Concerning the registration of engineers, the following resolution, moved by Gardner S. Williams, of Ann Arbor, Michigan, was adopted:

> Resolved, That it is the sense of this executive board that American Engineering Council should continue to collect and keep up to date a record of the engineers registration and licensing laws that may be proposed or passed, together with decisions thereunder for the use of the constituent societies of the Federated American Engineering Societies and others, but that it assumes no control over the actions of such constituent societies in regard thereto.

The executive board voted to cooperate in the movement to bring about uniform safety legislation, to broaden the program of its reforestation committee, to study the question of constituting the American Engineering Council a clearing house on elimination of waste, to further American participation in the proposed world power conference in London in 1924 and to work with the National Safety Council in plans for Conservation Week.

The sessions of the executive board were held at the Ohio Mechanics Institute, an inspection of which was made by the members of the board under the guidance of President John T. Faig. On the evening of March 23, the board members were the guests at dinner of the Cincinnati Engineers Club. Following the dinner there was a public meeting, President Cooley presiding. Speakers included Dr. Ira N. Hollis, L. W. Wallace, J. Parke Channing, Calvert Townley, O. H. Koch and several prominent Cincinnati engineers. The formal decision of the Indiana Engineering Society to enter the federation was announced by its president, W. H. Elliott, city engineer of Indianapolis. The speakers agreed that the federation was proving itself an effective instrumentality of organized engineering, that it would continue to make durable progress and that its permanence was virtually assured.

It was voted to hold the next meeting of the executive board in St. Paul, Minnesota, from June 8 to 9.

THE LOS ANGELES MEETING

THE seventh annual meeting of the Pacific Division of the American Association for the Advancement of Science, to be held in conjunction with a summer session of the American Association for the Advancement of Science and the Southwestern Division at the University of Southern California, Los Angeles, September 17, 18, 19 and 20, promises to be a unique event in scientific annals. The occasion of this meeting in Southern California is primarily the total eclipse of September 10, which will draw to this locality astronomers from all parts of the world. It is estimated that over fifty visiting astronomers will be present besides the local contingent from Mount Hamilton and Mount Wilson Observatories.

Besides a meeting of the American Astronomical Society and the Astronomical Society of the Pacific, it is planned to arrange a symposium on some subject of astronomical interest.

Paleontology will also be featured in the general sessions, illustrated by the discoveries of the Rancho La Brea beds.

The Society of Petroleum Geologists is planning to hold a meeting, also the American Meteorological Society, the American Society of Economic Entomologists, the American Phytopathological Society and the American Society of Agronomy.

The American Chemical Society will be represented by the California Section and the Southern California Section, and the various affiliated societies of the Pacific Division and

the Southwestern Division will be largely represented on the program.

Professor E. C. Franklin, president of the Pacific Division, American Association for the Advancement of Science, will preside over the general sessions and deliver the presidential address.

As a convention city Los Angeles offers many attractions. The mecca of tourists from all over the world, drawn by its balmy climate and picturesque surroundings, it is commercially and industrially one of the most important centers in the west. Its hotel facilities are unsurpassed. The accommodations for the meetings to be provided by the University of Southern California are extraordinarily well suited to the requirements. Large auditoriums for the general sessions and well-lighted commodious lecture halls for the scientific sessions are all housed in one building, a convenience which will be appreciated by all who have attended former meetings.

The preliminary announcement will be issued about June 1. Secretaries of sections and societies which are planning to hold meetings are urged to mail their announcements to the secretary, Golden Gate Park, San Francisco, not later than May 5 for inclusion in the preliminary announcement:

Following is a schedule of the sessions:

September 17, 1923. Monday morning: Meetings of affiliated societies. Monday noon: General session—research conference (12:15 to 2:00 P.M). Monday afternoon: General session—symposium on "Relativity" or some astronomical subject. Monday evening: General session—president's address by President E. C. Franklin and public reception.

September 18, 1923. Tuesday morning: Meetings of affiliated societies. Tuesday afternoon: Meetings of affiliated societies. Tuesday evening: General session—banquet and popular address.

September 19, 1923. Wednesday morning: Meetings of affiliated societies. Wednesday afternoon: Meetings of affiliated societies. A popular address may be arranged for this session by the local committee on arrangements.

September 20, 1923. Thursday: Excursions. Visiting members will be invited to inspect the equipment of Mount Wilson Observatory on this day.

W. W. SARGEANT
Secretary

SCIENTIFIC NOTES AND NEWS

DR. THEOBALD SMITH, director of the department of animal pathology of the Rockefeller Institute of Medical Research at Princeton, was elected on March 30 president of the American Association of Pathologists and Bacteriologists meeting in Boston. Other officers elected were: Dr. James Ewing of New York, professor at Cornell Medical School, vice-president; Dr. F. B. Mallory, director of the laboratory at the Boston City Hospital, treasurer; Dr. H. T. Karsner, professor at Western Reserve University, Cleveland, secretary.

THE French government presented the medal of the Legion of Honor to Dr. Victor C. Vaughan, on March 28, for meritorious service in science and in the world war. The decoration was presented at the Chicago Club by M. Barthelemy, the consul, in the presence of a few medical friends.

THE University of Arizona conferred the honorary degree of Doctor of Science on Mr. Henry Wallace, secretary of agriculture, on his recent (March 31) visit to Tucson. The only honorary degree previously awarded by the university was to General John Pershing.

THE University of Bordeaux has conferred an honorary degree on Professor Ramón y Cajal, the distinguished Spanish histologist. It is the first time a degree of the kind has been given by this university outside of France.

PROFESSOR M. W. P. BROEGGER, professor of geology at the University of Christiania, has been elected a foreign associate of the Paris Academy of Sciences, to succeed the late Professor Schwendener.

MAJOR GENERAL SIR WILLIAM B. LEISHMAN, director of pathology at the War Office, London, has been appointed to succeed Sir John Goodwin as director general of the British Army Medical Service.

DR. B. BARKER BEESON, Chicago, has been elected a corresponding member of the Paris Anatomical Society.

DR. JOSEPH MERRILL, dean of the Engineering College of the University of Utah, has been elected president of the Engineering Council of Utah, representing about fifteen hundred men of the engineering profession.

FREDERICK LAIST, chief chemist Anaconda Copper Mining Company, was awarded the James Douglas medal at the recent New York meeting of Institute of Mining and Metallurgical Engineers, for achievements in non-ferrous metallurgy.

MRS. ANNA BOTSFORD COMSTOCK, professor of nature study at Cornell University, has been nominated for the position of alumni trustee.

DR. ROBERT H. BOWEN, of Columbia University, has been elected treasurer of the American Society of Zoologists to succeed Dr. D. H. Tennent, resigned.

R. T. STULL, chief ceramist, U. S. Bureau of Mines, has been granted a leave of absence to accept the appointment of assistant general industrial agent of the Central of Georgia Railway, Savannah, Ga. He will devote his attention to the development of the mineral resources of the region traversed by this railroad.

G. F. MOULTON has resigned his position at the Bureau of Standards to accept a place as chemist of the research department of F. C. Huyck and Sons, Albany, N. Y.

AFTER twenty-six years of service with the Solvay Process and Semet-Solvay Companies, in Syracuse, New York, Alexis C. Houghton has resigned his position as chief chemist to enter service of the Bakelite Company, of New York. He will have charge of its synthetic phenol plant.

DR. CHARLES MOON, of Cornell University, has taken up work at the Bureau of Standards, in the section of induction and capacity, electrical division.

SABBATICAL leave of absence for the purpose of travel and study has been granted by the University of California to five members of the College of Agriculture: Dr. Elwood Mead, professor of rural institutions; S. B. Freeborn, assistant professor of entomology; E. C. Voorhies, assistant professor of animal husbandry; W. Metcalf, associate professor of forestry, and G. W. Hendry, assistant professor of agronomy.

DR. JOHN H. TANNER, professor of mathematics at Cornell University, has a leave of absence during this second semester, which he is spending on a trip to Europe and the Near East.

MR. N. GIST GEE, for twenty years professor of biology at Soochow University, China, has been appointed adviser on premedical education to the China Medical Board of the Rockefeller Foundation. He will make a study of the teaching of chemistry, physics and biology at colleges in China.

DR. T. H. MORGAN, professor of experimental zoology at Columbia University, gave three lectures at the University of Michigan on April 2 and 3, a public lecture entitled "Genetics and development" and two more technical lectures on genetics. On April 3 a luncheon was given in his honor.

ON March seventeenth, Professor W. F. G. Swann, University of Minnesota, Minneapolis, delivered an address at Toronto to the Royal Canadian Institute on the subject "The earth's electric and magnetic phenomena."

DR. EDGAR NELSON TRANSEAU, head of the department of botany at Ohio State University, gave four lectures on botanical subjects during the week of March 12th, at the University of Minnesota, under the auspices of the Plant Science Seminar and the Botany Club.

SOME time ago it was announced in SCIENCE that a committee had been organized to collect subscriptions for a monument to the memory of Professor Yves Delage, which his former students and admirers propose to erect near the marine laboratory at Roscoff. A number of Americans have in past years worked at this laboratory, and all biologists are indebted to Delage for his discoveries in marine biology, his organization of zoological science and his book on protoplasm and heredity. As the time is approaching when the subscription lists will be closed, this matter is once more brought to the attention of the readers of SCIENCE. Subscriptions to the memorial may be sent direct to Mlle. L. Dehorne, treasurer of the committee, at the laboratory of zoology, Sorbonne, 1, rue Victor-Cousin, Paris, 5e, or through any one of the American members of the committee, Frank R. Lillie, T. H. Morgan and Charles B. Davenport. SCIENCE is informed that any amount will be welcomed and should preferably be received before the middle of June next.

THE American Association of Immunolo-

gists held its annual convention in Boston on March 28 and 29, under the presidency of Dr. George W. McCoy, surgeon-general of the United States Public Health Service.

THE American and Canadian section of the International Association of Medical Museums met last week in the Boston City Hospital. Officers were elected as follows: Dr. F. B. Mallory, *president;* Dr. H. T. Karsner, of Cleveland, first *vice-president;* Dr. H. E. Robertson, of Rochester, Minnesota, *second vice-president;* Major James Coupal, of Washington, third *vice-president; councilors,* Dr. A. S. Warthin, of Ann Arbor; Dr. James Ewing, of New York; Dr. W. G. MacCallum, of Baltimore; Dr. William Boyd, of Winnipeg; Dr. H. S. Haythorne, of Pittsburgh; Dr. Carl V. Weller, of Ann Arbor; Dr. Stuart Graves, of Louisville; Dr. G. R. Callender, of Manila, P. I.; Dr. L. J. Rhea, of Montreal; Dr. Oscar Klotz, of Toronto; Dr. H. Marshall, of the University of Virginia; *secretary-treasurer,* Dr. Maude E. Abbott, of McGill University; *assistants,* Dr. H. N. Segall and Dr. E. L. Judah, of Montreal.

THE fifth annual meeting of the American Society of Mammalogists will be held in Philadelphia from May 15 to 17. Sessions the first two days will be devoted to the reading of papers, discussion and business, and will be held from 10 A.M. to 4:30 P.M. each day in the Academy of Natural Sciences, Logan Square. A session may also be arranged for the evening of May 16. As a part of the general program it is planned to have a symposium on field methods, including all phases of the subject. On May 17 the society will visit the Philadelphia Zoological Gardens as guest of the Zoological Society. There will also be opportunities to visit other institutions of interest to members, and the usual social functions will be arranged. Headquarters will be at the Aldine Hotel, Chestnut Street above Nineteenth Street.

AT a representative meeting of botanists held at the Linnean Society's rooms on March 2, it was decided to hold an Imperial Botanieal Conference of British and overseas botanists in 1924 about the beginning of July. An executive committee was appointed, with Sir David Prain as chairman; Mr. F. T. Brooks as honorary secretary, and Dr. A. B. Rendle as treasurer.

IT is stated in *Chemical and Metallurgical Engineering* that congress having failed to act on the proposal to increase salaries for chiefs of bureaus and scientific investigators in the Department of Agriculture, it has been determined to fill the vacancy in the office of chief of the Bureau of Chemistry at the earliest possible time. The place has been held open in the hope that a salary higher than $5,000 could be offered to those best qualified to fill the position. Dr. E. D. Ball, director of scientific work for the department, will appoint a consulting committee on which he hopes to induce some of the outstanding men in the chemical industry to serve. With this committee he will discuss not only the filling of the vacancy but the whole program of future work for the Bureau of Chemistry.

THE New York Academy of Sciences announces a prize of $250 offered by Mr. A. C. Morrison, fellow of the academy, to be known as the A. C. Morrison Prize for 1923 and to be awarded at the annual meeting on December 17. The conditions are: (1) Membership in good standing of the New York Academy of Sciences or one of the affiliated societies. (2) Papers are to be submitted on or prior to November 1. (3) The prize is offered for the most acceptable paper in a field of science covered by the academy or an affiliated society, which paper embodies the results of original research not previously published.

WILLIAM PHELPS ENO, of Washington, D. C., chairman of the board of directors of the Eno Foundation for Highway Traffic Regulation, Inc., has given Yale University $1,000 for three prizes of $500, $300 and $200 for students, to be awarded for a thesis supplemented by drawings on "The rotary system of traffic regulation and its application, with or without changes in curb lines, at foci or intersections of existing thoroughfares."

THE Richmond Pathological Society has appropriated $25 for a prize to be offered for the best original research work produced by undergraduate students of the Medical College of Virginia during each current year, the award

to be made under conditions prescribed by a committee consisting of the president of the society, chairman; Dr. Cook, professor of pathology; Dr. Noback, professor of anatomy, and the secretary. First, the prize will be awarded at commencement time. Second, the applicant must be a *bona fide* undergraduate student of the Medical College of Virginia.

PROFESSOR NORMAN R. CAMPBELL writes to *Nature*: "Surely the time has come to abandon the practice of attaching to elements fancy names arbitrarily selected by individuals. When names concerned nobody but a small clique in constant personal communication, and when they had nothing more important to record about an element than the personality of its discoverer, there may have been something to say for the system. Now-a-days neither condition is fulfilled. Thousands are interested who have no means of expressing their opinion; and there is something definitely scientific to be said about elements. The new element was discovered as a consequence of a theory of the structure of the atom, and its discoverers should surely be glad to see a record left in the name that their discovery was no lucky fluke. Dr. Aston, who has discovered at least twice as many elements as anybody else in the history of science, has set a good example; he has waived his right of naming, undoubted under the old dispensation. He has left them unnamed until a cousensus of scientific opinion has established a scientific system of nomenclature. Will not others follow his lead? Until its isotopic constitution is discovered, let us simply call the new element 72."

UNIVERSITY AND EDUCATIONAL NOTES

AT the University of Cambridge the admission of women students of Girton and Newnham Colleges to titular degrees in the university has now been approved. Among the other privileges granted to women students by the new regulations is included the right to be admitted to instruction in the university and to university laboratories and museums, though the number receiving such instruction at any one time is limited to five hundred.

THE chief engineer of the Westinghouse Electric and Manufacturing Company, Benjamin Garver Lamme; the engineer of the Philadelphia Electric Company, Paul Ortams Reyneau; and the superintendent of equipment of The All American Cable company, N. J. Perryman, will lecture at Yale this year to students in electrical engineering.

PROFESSOR W. S. WELLES has been made head of the Department of Agricultural Education at the Massachusetts Agricultural College to take the place of Professor William R. Hart, who retired on March 31.

PROFESSOR FODOR of the University of Halle, Germany, has arrived in Jerusalem to organize the plan for the biochemical institute of the Hebrew University of Jerusalem.

ADDITIONS to the endowment funds and gifts for current use amounting to about $1,200,000, received by the University of California since March 23, 1922, were read by President David P. Barrows at the annual Charter Day exercises. Four annual scholarships have been established at the Westinghouse Electric and Manufacturing Company, as a memorial to employees of the company and its subsidiaries who served in the world war. Each scholarship carries an annual payment of $500 for a period not to exceed four years, to be applied toward an engineering education in any technical school or college selected by the candidate. Scholarships are allotted by competitive examinations to (a) sons of employees in employ for five years or more; and, (b) employees continuously employed for at least two years and not over 23 years of age.

DISCUSSION AND CORRESPONDENCE

PROFESSOR LLOYD AND VEGETABLE CRYSTALS

PROFESSOR LLOYD attacks statements of mine regarding the formation of vegetable crystals, recently published in this *Journal*, because in his opinion they tend to invalidate views recently expressed by himself in the American Journal of Botany. The only reference made by him to the subject of crystals in that article is a brief one on page 157 which reads, "Chloroplasts and starch grains are usually present,

and a large stellate crystal of calcium oxalate is frequently, though not invariably to be seen." This meager statement is all that appears in this connection. It does not appear accordingly that Professor Lloyd's amour propre has really been affected by my remarks on the subject of crystallization in plants. His later expressions make it clear that it is rather the reaction of the Tong than of the individual, which is involved.

I must unfortunately take exception to some of Professor Lloyd's statements of fact. His description of his methods indicates that they are rather crude and he fails to make clear the relation of the cells described either to the growing point or to the cambium. The assertion that more than one druse is found in a cell is, whether intentionally or not, misleading. I have examined many thousands of microtome sections of the tissues at the growing point, and in proximity to the cambium in Ginkgo and various Dicotyledons. These sections have been made in all three planes, radial, tangential, and transverse, and in no instance have I ever seen satisfactory evidence of the occurrence of more than one druse in a cell. The only exception mentionable in this connection is in the case of the so-called crystal sand, commonly found in cells of the Solanaceae, etc. Here there is frequently a *single* druse accompanied by a *number* of simple crystals, but my statement was in regard to druses alone. If more than a single druse occurs in any case it must be a very rare and unusual occurrence and consequently having little bearing on the general situation.

Professor Lloyd affirms that in Ginkgo the young druses are not over half the dimensions of the nucleus. The incorrectness of this statement can readily be demonstrated objectively by photomicrographs taken in the region of the growing point and of the cambium. In these juvenile regions the nuclei of the cells are always much smaller than the diameter of the druses. Professor Lloyd's criticism that the colloidal central body in the druses "lacks the support of general observability and so becomes insubstantial" seems to reveal an inadequate technique, for invariably after removing the crystalline shell of the druse by appropriate solvents, notably weak hydrofluoric acid, the central body can be readily stained. Professor Lloyd's comparison of the "insubstantial" nucleus of the crystal with the string inside the stick of "rock candy" has the shortcomings characteristic of many mechanistic analogies. The internal central colloid substance of the compound crystal, unlike the "string," increases pari passu with the growing volume of the druse and clearly exerts an active influence both on its conformation and increase in size. The central body in crystals is in fact not only both clearly observable but is likewise very far from being "insubstantial." One interesting result of the detailed examination of crystals with adequate technique is the discovery that many forms which have been thought to occur freely in the cavity of the cell are in fact cystoliths. Cystoliths of calcium oxalate appear in fact to be much more prevalent than the well known ones of calcium carbonate, from which they differ decidedly both in form and mode of origin. I must reiterate my statement that in the case of large druses, such as are common in Ginkgo and Carya, the growth of the compound crystal continues long after all peripheral protoplasm outside has disappeared. The expanding crystal in such cases clearly brings about not only the enlargement of the cell-wall but in many instances a reshaping of its configuration to correspond to the projecting spines of the contained crystal. The truth of this statement can easily be demonstrated by the objective evidence of photomicrographs. In comparing the growth of the crystal with the development of the coats of spores Professor Lloyd seems to deal with matters which are fundamentally different.

Finally I must state that I agree heartily with Professor Lloyd that "it still remains legitimate to use what we do know to explain what we do not," but this formula should be qualified by the reservation that we must be sure that we really know what goes on in the body of living beings before we attempt to make comparison with analogous chemical and physical conditions. The mechanistic highway is strewn with wrecks arising from the neglect of this consideration. We need only mention Sachs' long held fallacious demonstration that the water must pass up through the walls of the cells of the wood because it could not possibly make its way, on physical and chemical grounds, through the lumina or cavities of the tracheids

and vessels. It may further be pointed out that no real progress was made in the study of the development of starch grains until Meyer began at the morphological end and proved that the layering was not due to any recondite physical or chemical causes as previously asserted, but rather to alternations of night and day. Such examples could be multiplied indefinitely.

It is an interesting feature of the study of religions that converts are always the most bitter assailants of the views they once held. Extremely good illustrations of this principle can be supplied from the ranks of the morphologists, who in recent years by reason of faith or expediency have turned to physiology or genetics. The set of the biological tide has however again turned towards morphology and in the near future we are likely to have abstruse problems, both genetical and physiological, receive needed light from this quarter. Nor has the fundamental biological study of the origin of species passed, as was predicted years ago, from the field to the laboratory. The field is still much more important. Experiments *in vitro*, whether in glassware or greenhouses, need to be interpreted in the clearer atmosphere of the world outside. This situation was doubtless in Professor Conklin's mind when he recently called attention to the relatively slight evolutionary results, flowing from the huge experimental activities of the past twenty years.

E. C. JEFFREY

COLORED HEARING

THE following incident seems to have several points of interest:

FULTON (aged three years, 11 months, listening to the phonograph): "Daddy, I think soft music is yellow."

DR. P. (his father, a distinguished chemist): "Yellow? And what color is loud music?"

FULTON: "Well, it is black."

DR. P.: "And what is blue music like?"

FULTON: "Blue music is loud, but not so loud as black music."

DR. P.: "Tell me, why is soft music yellow?"

FULTON (after thinking a moment): "Well, when you mark with yellow crayon on paper, you can't see it very well, but when you mark with black, you can."

Dr. P. had read an article in SCIENCE about colored hearing and explains his interest in his son's remark by the fact that it seemed to suggest a possible hypothesis as to the origin of such phenomena. The first point to notice, therefore, seems to be that there is a distinct value in such a journal as SCIENCE with its appeal to scientific men of all complexions.

For there are certain regions in which the psychologist as well as the biologist is in much the position of the astronomer, of having to wait for phenomena to occur under non-experimental conditions. Even if colored hearing could be experimentally induced, we should have little guarantee that it is the same as that "normally" possessed by many persons. It would be unduly tedious for psychology to have to wait for such evidence to be collected solely by psychologists from the observation of their own children, even were they as a class far more fecund than is the case.

The suggestion of the incident is, of course, that such associations between sounds and colors might be gradually strengthened while the connecting link dropped out of sight. Dr. P. is carefully avoiding any suggestion to the child and, at a later date, an attempt will be made to see whether the association has developed or has disappeared.

Have other readers of SCIENCE relevant observations?

HORACE B. ENGLISH

ANTIOCH COLLEGE

ACETONE IN TISSUE WORK

I WAS much interested in Professor F. M. McFarland's note (SCIENCE, July 14, 1922) on the use of acetone in place of alcohol in preparing paraffin sections for microscopic examination. Essentially the same method has been used in the laboratory of the CLINIC for about two years. Merck's acetone, U.S.P., is used. The steps in staining the slides are passing them through a series of Coplin jars as follows: two of xylene, two of acetone, one of water, one of hematoxylin, one of distilled water, one of tap water, one of acetone, one of acetone saturated with eosin, and two of xylene. The results appear quite as satisfactory as when alcohol is used in passing to and from water. State and federal regulations and restrictions for obtaining alcohol together with the high internal revenue tax make its use

almost prohibitive. In calling attention to the suitability, if not superiority, of acetone as a decolorizer in Gram's method of staining bacteria I briefly referred to the suitability of acetone in the process of staining sections (*Journal* of the American Medical Association, Volume 75, page 1017, October 9, 1920). Of course the well-known use of acetone in dehydrating preparatory to embedding is also employed.

M. W. LYON, JR.

SOUTH BEND, INDIANA

WEALTH AND BENEFACTIONS

Now comes Dr. Pritchett with the hint that accumulated wealth can not even be *given away* to the benefit of the public. And the question is—what ground is left on which to defend large fortunes? Socialists have always declared against them. The one defense which they have never quite gotten round is that wealth makes benefactions possible and supports the public good in a way that this could not be done—or *would* not be done—by small contributions or general assessment. Millions of curses on the octopus have been checked by the thought that—perhaps, after all— . . . . considering the universities— . . . . and then there's the science of medicine— . . . . and then to think of art— . . . . and after all we do need *philanthropists*— . . . . Without such thoughts as these, who would defend the poor rich man? Mr. Pritchett does not tell us whether he will or not. The evident gloom of spirit in which he writes shows that he is groping after truth (not a bad thing to grope after). It might even indicate a fear that when the truth is found it may be disagreeable. It surely would be if it told us that our standard argument for great fortunes is mere *buncum*.

But this question just now is before scientific men. How will they handle it? Presumably if the accepted solution proves false others will be tested. At least the problem will be analyzed. What are the alternatives? If money can not safely be given away in large sums, how about small sums? The corrupting effect might thus be distributed so that no one man or institution would suffer so much. As an extreme supposition the whole fortune might be turned into the public treasury and every man's tax bill decreased accordingly.

Of course, the fortune might be left to one or more heirs (presumably incapable of corruption). In this case the fund might either endow a permanent aristocracy or the problem might be solved by the wasting of the money. Neither of these solutions would find many champions among thoughtful men.

To suggest that the rich man should give away his own income or accumulations does not help. Mr. Pritchett's report does not assume that the injury done by gifts is in any way determined by their immediate source.

The one remaining choice would seem to be to manage a very lucrative business in such a way that profits shall be distributed as earned among all concerned and even shared with the public by reducing prices when their size becomes unseemly. This, of course, is rank labor unionism and has been answered a thousand times by men of good "business judgment" who are accumulating fortunes. It is only mentioned here to complete the list of possible solutions.

The writer of this modest inquiry finds himself groping among these possible alternatives for a solution that is better than the one employed hitherto. He would like to see some incomes, now derived from *private taxation*, reduced to the point that ledger accounts could be published without scandal, but beyond that his fear of socialism almost makes him willing to incur the risks of injury which attend the acceptance for his own institution of a share of that embarrassing money of which Mr. Pritchett writes, rather than see our rich men rush into "untried experiments."

Meantime, he wishes to say that the above paragraphs are not written in jest. The difficulties suggested in Mr. Pritchett's report may be more real than we like to admit, and in that case the alternative solutions must be faced. What if Mr. Pritchett and the socialists were both right?

MODEST INQUIRER

QUOTATIONS

RESEARCH AND TEACHING

I HAVE recently been reading the programs of the meetings of representative American learned societies and it is astonishing to find the rapidly growing numbers of the com-

munications which originate with the employees of the great business activities of the country. These papers are by no means wholly of an applied or utilitarian character. There is an abundance of pure science, of abstract discussion, obviously encouraged by the business administrations in question. In other words, the promotion of pure science has been acknowledged as exceedingly good business. The American business man has been quick to appreciate the value of research, once its meaning was brought home to him, and he is now enthusiastic in opening new paths to hiding-places of nature. That such paths are apt to lead undeviatingly from his own private domain is here of secondary importance.

The reaction of all this on the professor may well be looked at with misgiving. The college in the future, as heretofore, will necessarily insist on the primary importance of teaching. Instructors come to us with functionally well-equipped brains, aglow with the brightness of a young man's ardor, strong in the beautiful hope of achievement and with youth's illusions all undimmed—only to be forever confronted by the elusive response of the average student. Nothing is so deadening as the prolonged contact with the uninformed, the indifferent; for it keeps a low standard of comparison always in view. Eventually a man will measure his own mental stature by its elevation above that humble level. If the incentives to a stimulating competition, to an emulation among professional compeers, are also lacking, the distortion of intellectual values may be complete. A persistent urge, like a physical field of force, however weak, is a very dangerous agency. Watching sleeplessly, like Satan, over the course of things, it may even convert a faculty of high aims and specifically equipped scholarship into a body of schoolmasters. The exalted obligation incident to exceptional training is creative, an enlargement of the boundaries of knowledge, a new voice in art; but its fruition may degenerate into some academically dignified clerkship. A mute inglorious Darwin may be detecting new group affinities among old courses, or piecing together the parts of some academic picture puzzle. It is not the strong bias, but the monotonous continuity of petty bias that quenches. At some instant of flickering the sacred flame is blown out.

In the end, I fear, the trusts, as we fondly call them, will have absorbed and assimilated *l'élan vital*, the soul of the university. It is they who will point out to our bewildered gaze the sweep of new horizons and the flotsam from undiscovered shores. Our faculties will have to teach what they have been taught by the great business corporations. These will hereafter break new pathways into the unknown, and it will be for us to tell the uninformed the Ultima Thule of their progress. The university will be the humble expository mechanism of the intellectual accomplishments of commercial enterprise. In brief, there will be a complete inversion of the method by which the world's knowledge has deepened in the past.

If one looks, for instance, at the highly ingenious contrivances by which the marvels of the Hertzian wave have recently been brought to the appreciation of the people, one is struck by the appearance on every clamp, every ferrule, every coil, every tube, almost on every plate and screw of the mysterious symbol, PAT. This PAT. is a cipher more potent than any formula of Cagliostro. It is behind an array of PAT. that the wisdom of the future will be entrenched, and above which so much of it as may be vouchsafed us will be broadcast. Our function will resemble the town crier's, to herald the information somebody else has wrested from the infinite. We shall still be interested and keenly watchful, no doubt, like the little cherubs with wrapt gaze at the feet of the Sistine Madonna; but the great inspiration will float majestically above us.—*Dean Barus in the annual report of the president of Brown University.*

THE TECHNICAL PAPERS OF THE NATIONAL GEOGRAPHIC SOCIETY

THE National Geographic Society announces a series of technical papers embodying the scientific results of its Katmai, Alaska, expeditions. The first number entitled "The origin and mode of emplacement of the great tuff deposit of the valley of ten thousand smokes," by C. N. Fenner, is now ready.

Dr. Fenner's paper gives details of the hot sandflow not included in the nontechnical volume, "The valley of ten thousand smokes,"

by the writer, recently published by the National Geographic Society.

This series of papers from time to time will embody researches in diverse fields of science resulting from National Geographic Society expeditions. Notices of their appearance will be sent to all who desire such notification. The papers themselves will be distributed only to those who specifically request them.

An abstract of Dr. Fenner's paper follows:

The valley of ten thousand smokes is filled with a thick deposit of fragmental material, which was extruded during the great eruption of 1912. Although similar in composition to the ashfall from Katmai, this material evidently flowed down the valley under gravity like a liquid. At the time of its extrusion it was highly heated, for all vegetable matter which it touched was completely reduced to charcoal.

Several lines of evidence indicate that this tuff could not have come from the crater of Katmai: (1) The slopes down which it would have flowed are covered with a large glacier whose surface bears no indication that an avalanche of hot material passed over it. (2) The topographic relations of the several parts of the deposit make it practically impossible that Katmai crater or any other single source (either outside the valley or within its borders) could have supplied the material to all areas that it covers.

It is concluded, therefore, that the tuff must have come from a number of vents, and further inquiry reveals no other probable source than the fissures that have disrupted the valley floor (and to a less degree, the floor of Katmai Pass and the lower slopes of Trident) and are now marked by lines of fumaroles.

At the time of its extrusion the temperature of the material was sufficiently high not only to carbonize tree trunks but probably to produce secondary explosions where it came into contact with streams of water.

The extrusion of this material preceded the explosion of Katmai, as its surface is, in general, covered by the ashfall.

Most of the material is a highly silicious glass, inflated into pumice or shattered to fine dust, but mingled with this is a considerable amount of basic pumice and scoria, together with fragments of old andesites, sandstone and shale. The old basic rocks have been much digested by the new magma, producing great quantities of banded pumice in which both old and new components are easily distinguishable. The sediments are attributable to the Jurassic strata that underlie the valley everywhere, but the source of the old volcanics is more of a problem.

Something of the conditions of digestion of the old lavas can be learned from a study of Novarupta volcano, the largest vent in the valley, which is now plugged by a "dome" of highly viscous lava. A large amount of old basic lava evidently became involved in the newly rising silicious magna and was melted down by it. The author believes that the source of this old basic material was derived from the morainal deposits rather than from bed rock below the vent.

It is thought that the best explanation of the practical restriction of fissures to the valley floor is that a sill-like wedge of magma was intruded between the horizontal strata underlying the valley and produced by its upheaving action a block-like fragmentation of the roof where thinnest. The fractures then served as orifices of extrusion for portions of the magma.

The surface outburst seems to have behaved very much like the *nuées ardentes* of Pelée and La Soufrière and to have spread as a hot sandflow through the valley. A surprising feature is the extremely low angle of repose (little more than 1 degree) finally assumed. This and other features seem best explained by supposing that evolution of gas from the magma continued during the movement of the sandflow and was the central feature of it. The characteristics of this form of eruption and the factors to which they are due are discussed in some detail.

SPECIAL ARTICLES

THE PRECIPITATION OF METALS BY HYDROGEN SULFIDE

IN connection with Professor Neuhausen's[1] appreciative discussion of a note of mine[2] on the precipitation of metals by hydrogen sulfide, I desire at this time to call attention to a newly

[1] SCIENCE, Vol. LVII, No. 1462, p. 26, (1923).
[2] *J. Am. Chemical Soc.*, 44, 1500 (1922).

discovered instance which appears to have a significant bearing on the subject. This, of course, is merely a preliminary notice; the details of an extensive investigation concerning the interaction of hydrogen sulfide and metallic salt solutions, which is being carried on in collaboration with Mr. Waldo L. Semon, will, it is hoped, be ready for publication within the next year or two.

As a starting point, the reader is requested to call to mind the white precipitate, whose intermediate formation is always observed when hydrogen sulfide is passed into a solution of mercuric chloride strongly acidified with hydrochloric acid; and which may also be prepared by treating freshly precipitated mercuric sulfide with a solution of mercuric chloride. The composition of this white substance is represented by the formula, $HgCl_2 . 2\ HgS$; and the analogous double nitrate, $Hg(NO_3)_2 . 2\ HgS$, is a familiar substance, as well. Formally, at least, these compounds are analogous to the addition products of mercuric chloride with organic sulfides, as $HgCl_2 . 2\ S(C_2H_5)_2$.

In the writer's opinion, all these compounds are complexes, more or less analogous to the well-known platinum complexes, $[Cl_2Pt(SR_2)_2]$, $[Pt(SR_2)_4]Cl_2$, etc.; and it is thought probable that their formation may be a consequence of the previous formation and decomposition of unstable addition products of mercuric salts with hydrogen sulfide itself, or of the intermediate ions of such salts with hydrosulfide-ion, or both. But, unfortunately, the transitional mercuric double salts in question are insoluble, or else very unstable, and therefore they do not readily yield to investigation. For that reason, we have sought in many ways to prepare soluble inorganic compounds of this nature.

Apparently, we have met with some success in working with mercuric perchlorate, $Hg(ClO_4)_2 . 4H_2O$. This salt was prepared by dissolving mercuric oxide in an appreciable excess of perchloric acid, followed by evaporation to a small volume, and crystallization. It should be noted that mercuric perchlorate in its reactions resembles mercuric nitrate rather than the chloride, and that perchloric acid and hydrogen sulfide do not interact in aqueous solution.

The Interaction of Mercuric Perchlorate and Hydrogen Sulfide, and of Mercuric Perchlorate and Mercuric Sulfide.—Freshly prepared (approx. 0.08 molal) hydrogen sulfide solution was slowly run from a burette into a solution of 2.0 g. of crystalline mercuric perchlorate in 25 cc. of water. Each drop produced locally a flocculent black precipitate, *which quickly redissolved on shaking.* The reagent was run in with shaking, in 1 cc. portions, as long as the precipitate continued to redissolve. The clear, colorless liquid soon acquired a brownish opalescence, but nevertheless it continued to redissolve the precipitate, more and more slowly, as produced, until in all about 32 cc. of the hydrogen sulfide solution had been added. The further addition of the reagent yielded a permanent precipitate, which however showed no tendency to settle until the further addition amounted to 26 cc.; even then, the clear supernatant liquid gave no test for hydrogen sulfide until the further addition amounted in all to 28 cc. It is seen, therefore, that about 60 cc. of the reagent was required for the complete precipitation, and that of this quantity about one half was consumed in each phase of the reaction. The latter observation was confirmed by the following experiment.

The black precipitate, obtained as above from 2.0 g. of mercuric perchlorate, was freed as far as possible from the supernatant liquid by decantation, after which it was washed twice by decantation with water. It was then treated with a solution of 2.0 g. of mercuric perchlorate in 30 cc. of water, added in small portions, with shaking; the whole quantity was required in order to just redissolve the black precipitate. The resulting solution was transparently clear, with a brownish opalescence, and left only a trace of residue upon filtration. The behavior of the solution thus formed is of considerable interest, especially in connection with the formation of the well-known white precipitate, $HgCl_2 . 2\ HgS$, which is observed as a transition product in the precipitation of mercury by hydrogen sulfide in the presence of chlorides.

Small portions of the freshly prepared solution were found to give white precipitates with sodium chloride or hydrochloric acid, nitric acid and sulfuric acid—all containing mercury and sulfur, and presumably of the compositions represented by $HgCl_2 . 2\ HgS$,

$Hg(NO_3)_2 . 2\ HgS$, and $HgSO_4 . 2\ HgS$. The bulk of the solution, upon standing overnight in a small stoppered flask, deposited an almost white precipitate, and the supernatant liquid contained only mercuric perchlorate and perchloric acid. This precipitate, which can readily be obtained pure and white, was found to correspond in composition to the formula, $Hg(ClO_4)_2 . 2\ HgS$. It will be more fully described in a future publication.

In conclusion, it is desired to emphasize that the solution obtained by the interaction of 2 mols of mercuric perchlorate and 1 mol of hydrogen sulfide, or of one mol each of mercuric perchloride and sulfide, contains a complex salt which on the one hand reacts with soluble chlorides, nitrates and sulfates to yield more or less insoluble precipitates, and on the other hand spontaneously decomposes in accordance with the equation, $2[Hg(ClO_4)_2 . HgS] = Hg(ClO_4)_2 . 2\ HgS + Hg(ClO_4)_2$.

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EFFERENT CHARACTERISTICS OF RECEPTION CENTERS

THE peripheral efferent nerves of mammals arise as axones of cells having a definite type of structure, a structure characterized by the arrangement of the Nissl substance within the cell in large sharply defined granules. Other efferent cells closely related to the peripheral efferent neurones have been shown by Jacobsohn to present much the same type of structure, and in a previous article I have described the location of these cells in various regions of the brain; such cells may be termed premotor to express their functional and structural relation to the peripheral motor cells.

Further study convinced me that due to the complex relations within the central nervous system a rigid classification of nerve cells into types would offer little hope of elucidating the functional significance of cell structure. We do not know what determines the structure of a nerve cell, but it must be related at least partly to the stimuli which the cell receives. Since the activity of the central nervous system consists essentially of diffusion of impulses through diverse paths and recombination into new paths it is evident that, while in some cases the total stimulus to two nerve cells may be practically identical or else very different, in many cases two cells may receive stimuli which are similar in some respects but different in others. I consider cell activity (function) and cell structure (together with size and form) as complexes and have attempted partially to analyze each of them, observing under what functional conditions a certain character of cell structure constantly appears in cells otherwise structurally different. Thus the structural characteristic of efferent cells is the presence of relatively large and discrete Nissl granules, while the large size and polygonal form which such cells often exhibit are not directly related to their efferent function but to other aspects of cell activity.

Having isolated from the complex of cell structure the element corresponding to the efferent tendency it was then possible to identify this structural character in cells known to be more remotely related to the musculature than are the peripheral efferent cells or those pre-motor cells closely related to them; and as the relation of the cell to the peripheral efferent neurones became more remote the cell showed a corresponding change in the efferent character of its structure, the Nissl granules becoming smaller and often less sharply defined. In studying the more remote efferent cells I was finally confronted with the fact that many so-called sensory centers contain at least some cells with a structure as characteristically efferent or even more efferent than that of certain undoubted efferent cells. This efferent character of cell structure as revealed in reception centers of the human brain and cord will now be considered.

Our knowledge of reception centers for general proprioceptive sense is limited largely to those related to the spinal nerves. The peripheral efferent column of gray matter is a reception center for general proprioceptive impulses involving the simpler reactions, and the failure formally to include it among the proprioceptive reception centers has tended to obscure the relation between afferent and efferent nerve centers. Another proprioceptive center is Clarke's column, whose cells are structurally related to the efferent type; these cells send their axones to the cerebellum, and the significance of this connection will appear later. The